

LSI DOCKET NO. 03-1141

CLAIMS:

What is claimed is:

1. A diffusion resistor comprising:

5 a substrate containing a well;

a diffusion region formed within said well, said diffusion region having predominantly p-type dopants;

10 a first contact region and a second contact region, both of said first and second contact regions extending down from a surface of said substrate and containing predominantly p-type dopants;

15 a third contact region and a fourth contact regions, both of said third and fourth contact regions extending down from said surface of said substrate and containing predominantly n-type dopants, wherein said third and said fourth contact regions are located between said first and said second contact regions, said third and fourth contact regions defining a conduction channel therebetween; and

first, second, third, and fourth contacts attached respectively to said first, said second, said third, and said fourth contact regions;

wherein said first contact and said second contact form terminals of said diffusion resistor;

20 wherein said third contact and said fourth contact each forms a diode such that application of a voltage to said third contact and said fourth contact forms respective depletion regions that change in size depending on a value of said voltage;

whereby a resistance in the depletion resistor is changed by changing said voltage.

25 2. The diffusion resistor of claim 1, wherein said first contact, said second contact, said third contact, and said fourth contact are connected to said surface by respective salicided regions.

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3. The diffusion resistor of claim 1, wherein said first contact, said second contact, said third contact, and said fourth contact are formed using a metal layer.

5 4. The diffusion resistor of claim 4, wherein said metal layer comprises tungsten.

5. The diffusion resistor of claim 1, wherein said diffusion region contains p-type dopants having a concentration of about $1 \times 10^{15}/\text{cm}^3$.

10 6. The diffusion resistor of claim 1, wherein said first contact region and said second contact region contain p-type dopants having a concentration of about $1 \times 10^{18}/\text{cm}^3$ to about $1 \times 10^{20}/\text{cm}^3$.

15 7. The diffusion resistor of claim 1, wherein said third contact region and said fourth contact region contain n-type dopants having a concentration of about $1 \times 10^{18}/\text{cm}^3$ to about $1 \times 10^{20}/\text{cm}^3$.

8. The diffusion resistor of claim 1, wherein said n-type dopant is arsenic or phosphorus and said p-type dopant is boron.

20 9. The diffusion resistor of claim 1, wherein said well is a p-well.

10. A method for forming a diffusion resistor, the method comprising:

forming a well in a substrate;

forming a diffusion region, having a predominantly p-type doping, in said well;

25 forming a first contact region and a second contact region in said diffusion region, said first contact region and said second contact region extending downward from a surface of said substrate and each contain predominantly p-type doping;

forming a third contact region and a fourth contact region between said first and said second contact regions, said third and said fourth contact regions extending downward from a

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surface of said substrate, comprising predominantly n-type doping, and defining a conduction channel therebetween; and

forming a first contact, a second contact, a third contact, and a fourth contact respectively on said first contact region, said second contact region, said third contact region, and said fourth
5 contact region;

wherein said third contact and said fourth contact form respective diodes such that application of a voltage to said third contact or said fourth contact forms a respective depletion region that changes in size depending on the value of said voltage;

whereby a resistance in the depletion resistor is changed by changing said voltage.

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11. The method of claim 10, wherein said step of forming said diffusion region comprises: implanting p-type dopants into said substrate.

12. The method of claim 11, wherein said p-type dopants implanted into said diffusion region
15 have a concentration of about $1 \times 10^{15}/\text{cm}^3$

13. The method of claim 11, wherein a doping profile of the p-type dopants is selected to reduce parasitic capacitance.

20 14. The method of claim 10, wherein said step of forming said first contact region and said second contact region comprises:

implanting n-type dopants into said depletion region in a concentration of about $1 \times 10^{18}/\text{cm}^3$ to about $1 \times 10^{20}/\text{cm}^3$.

15. The method of claim 10, wherein said step of forming said contacts comprises:
25 depositing a metal layer onto said first, second, third, and fourth contact regions.

16. The method of claim 15, further comprising the step of forming a salicide layer between each of said contacts and a respective contact region.

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17. The method of claim 16, wherein said salicide layer comprises titanium.
18. The method of claim 15, wherein said metal layer is a tungsten metal layer.
19. The method of claim 10, wherein said well is a p-well.